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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
08/636,069	04/22/1996	GURTEJ S. SANDHU	MICR155(95-0	2399

7590 12/04/2002

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EXAMINER	
KIELIN, ERIK J	

ART UNIT	PAPER NUMBER
2813	37

DATE MAILED: 12/04/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 08/636,069	Applicant(s) SANDHU ET AL.	
	Examiner Erik Kielin	Art Unit 2813	

-- Th MAILING DATE of this communication appears on th cover sheet with the correspond nce address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 October 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-6 and 31-54* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *31-41,51 and 52* is/are allowed.

6)☒ Claim(s) *1,2,4-6,43-50,53 and 54* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

1. In view of the Appeal Brief filed on 1 October 2002, PROSECUTION IS HEREBY REOPENED. A new ground of rejection is set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) request reinstatement of the appeal.

If reinstatement of the appeal is requested, such request must be accompanied by a supplemental appeal brief, but no new amendments, affidavits (37 CFR 1.130, 1.131 or 1.132) or other evidence are permitted. See 37 CFR 1.193(b)(2).

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims **1**, 2, 4-6, and **43**, 44 and **45** and **53**, 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 02-050966 (**Hisamune**) in view of US 5,166,101 (**Lee** et al.) and considered with the basic text **Pierson**, Handbook of Chemical Vapor Deposition, Noyes Publications: Park Ridge, New Jersey, 1992, pp.26-27 -- especially step (c) on page 27, and the article **Inoue**, et al. "Growth of SiO_2 thin film by double-excitation photoinduced chemical vapor

deposition incorporated with microwave excitation of oxygen" Journal of Applied Physics 64(11), 1 Dec. 1988, pp. 6496-6501.

Regarding independent claims 1, 43, 45, and 53, **Hisamune** discloses a method of depositing a phosphorous-doped silicon dioxide layer on a substrate surface comprising,

heating a substrate to a temperature of about 400 °C in one example (p. 6, last paragraph);

contacting the substrate with a reaction volume of gas located above the substrate surface within a chemically reactive distance of the substrate, the reaction volume of gas comprising TEOS --as further limited by instant claim 2, trimethylphosphite as further limited by instant claims , and ozone (pp. 5-7);

illuminating the reaction volume of gas from a high intensity light source such as a mercury lamp (pp. 5-7, Fig. 1); and

subjecting the reaction volume of gas to a "normal pressure or reduced pressure," (translation, p. 6, last paragraph) wherein "normal pressure" is normal atmospheric pressure or 760 Torr, since "normal pressure" is not "reduced pressure."

Because **Hisamune** is illuminating the entire gas volume above the substrate, "the reaction volume" --by Applicant's definition-- is necessarily illuminated. Applicant defines the reaction volume on p. 7, lines 15-20 as,

> "The reaction volume of the gases that is exposed to the optical excitation in this process is **meant to describe the volume of gas located within a chemically reactive distance of the substrate**. The gas volume located in this vicinity is sometimes described in terms of the type of chemical reaction it tends to undergo. The **reactant gases in the reaction volume are referred to as taking part in heterogeneous chemical reactions**, rather than homogeneous reactions taking place in the gas volume in the rest of the chamber." (Emphasis added.)

Moreover, the limitation "the reactant gases in the reaction volume taking part in heterogeneous chemical reactions, rather than homogeneous reactions taking place in the gas volume in the chamber outside the reaction volume" is also necessarily met because Applicant has defined the reaction volume by the existence of the presence of heterogeneous reactions and the absence of homogeneous reactions. The specification merely *defines* such homogeneous reactions as those which occur outside "the reaction volume," but does not limit homogeneous reactions from taking place. Note additionally that all CVD reactions leading to deposition inherently have a reaction volume as shown in the basic text of **Pierson**, Handbook of Chemical Vapor Deposition, Noyes Publications: Park Ridge, New Jersey, 1992, pp.26-27 -- especially step (c) on page 27, the section entitled, "3.1 Deposition Sequence" which state shows that CVD deposition reactions occur by the reactive species diffusing to the surface of the substrate and then reacting at the substrate surface, i.e. being a "chemically reactive distance" from the substrate surface.

The limitation that the functional atomic oxygen concentration is inherently met because the article by **Inoue** teaches that UV irradiation of ozone, O_3, increases the functional oxygen concentration and **Hisamune** irradiates O_3 with UV light from a mercury lamp just as does **Inoue**. (See **Inoue**, p. 6498, section entitled, "2. Oxygen excitation" which states in pertinent part, "O_3 molecules are decreased by the irradiation of the UV and VUV light. This indicates that O_3 molecules absorb the UV light and are decomposed to O_2 molecules and oxygen atom radicals $O(^1D)$.")

Further in this regard, the limitation that the fixed charge in the deposited film is reduced is also inherently met because Applicant's specification specifically states that it is the atomic

oxygen which reduces fixed charge by reducing carbon content from the organic precursors. (See instant specification, paragraph bridging pages 7 and 8.) In as much as **Hisamune** uses parameters of temperature and pressure which are clearly as disclosed in Applicant's *specification*, it would be wholly impossible for the dielectric film produced by **Hisamune** to *avoid* a reduction in fixed charge --especially since it is the atomic oxygen which Applicant indicates is the means by which the fixed charge is reduced, not the presently claimed temperature and pressure ranges. Otherwise, Applicant's specification must be admittedly not enabled since both temperature and pressure ranges --which have been indicated to work in the instant invention-- would then, somehow, have to not work, in contradiction to the instant specification.

Hisamune does not teach a second dopant or specifically a boron dopant source is added to the gas mixture to form the glass layer but does teach phosphorous dopant source of for example trimethylphosphite, TMP, (translation, p. 6, line 7) is added -- as further limited by instant claim 4.

Further regarding the independent claims above and also regarding claims 4, 6, 44, and 54, **Lee** teaches the benefits of using two dopants including both a boron dopant, such a trimethyl borate and a phosphorous dopant, such as that already used in **Hisamune**, along with the TEOS and ozone to form, by CVD, a borophosphosilicate glass layer for integrated circuit applications, just as does **Hisamune**. (See **Lee**, col. 4, lines 10-34 and Fig. 2.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to add a boron dopant to the gas mixture of **Hisamune** to form BPSG because **Hisamune** teaches that phosphosilicate glass can be made by a photo-CVD process, and the addition of boron to the

glass is beneficially used in integrated circuit applications to form planarized layers, as taught to be known in the art in **Lee**. (See **Lee**, col. 1, lines 17-23.)

Then the only difference is that the temperature range of 480 to 700 °C is not expressly taught in the exemplary embodiment of **Hisamune**. Note however that **Hisamune** states at p. 6 of the translation,

> "Since chemically active ozone is utilize in this case, SiO_2 growth **can be achieved** at a low temperature of 400 °C or less at sufficiently high speed in either normal pressure or reduced pressure. Moreover, since film formation is carried out under ultraviolet ray irradiation, formation of a compact film is possible **even at a low temperature** of 400 °C or less." (Emphasis added.)

While **Hisamune** teaches that temperatures of less than 400 °C still achieve "sufficiently high" deposition rates and compact PSG film, **Hisamune** is not limited to such low temperatures. This is merely an advantage of using O_3 and UV irradiation. Moreover, **Lee** teaches that typical deposition temperatures of 390 to 600 °C are used for CVD of BPSG.

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use a temperature range of 480 to 760 °C as the deposition temperature in **Hisamune** (1) because **Lee** teaches that such temperature range is useful for forming BPSG; (2) because such higher temperatures are clearly considered by **Lee** since **Lee** indicates that 400 °C or less provides "sufficiently high [deposition] speed" thereby suggesting that higher temperature would provide even higher deposition speed which is desired in the art to reduce processing time and thereby increase device throughput; (3) because it has been held that claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from

the results of the prior art (*In re Huang*, 40 USPQ2d 1685, 1688(Fed. Cir. 1996), yet the evidence of record indicates that there would exist *no* unexpected result different in kind and not merely in degree because Applicant's specification specifically states that temperatures of 200 to 780 °C are the operable temperatures ranges for the invention which overlaps those temperatures used in both **Hisamune** and **Lee**. (See instant specification, p. 7, line 6.)

Regarding claim 5, **Hisamune** disclosed nitrogen carrier gas. (See pp. 6-7.)

4. Claims **46**, **47**, **48**, 49, and **50** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Hisamune** in view of **Lee** and EP 0 562 625 A2 (**Imai** et al.).

The prior art of **Hisamune** in view of **Lee**, as explained above, disclose each of the claimed features, either expressly or inherently, except for using a fluorine dopant in the SiO_2 or BPSG film.

Imai teaches the benefits of forming a fluorine-doped BPSG (FBPSG) film to reduce the reflow temperature below that of BPSG alone. (See Abstract.) The FBPSG film is produced by a CVD method wherein ozone, TEB, TMOP, and FTES are used to form the FBPSG layer. (See section entitled "FIRST EMBODIMENT" beginning on p. 6.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to add fluorine to the glass layer of **Hisamune** in view of **Lee** to reduce the reflow temperature of the glass layer as taught to be beneficial in **Imai**.

Allowable Subject Matter

5. Claims **31**-36, 38-41, **42**, **51**, and **52** are allowed.

6. The following is a statement of reasons for the indication of allowable subject matter:

The prior art of record does not teach or suggest, in combination with the other claimed features, that the substrate surface is not directly exposed to the light while at the same time illuminating the reaction volume above the substrate.

Response to Arguments

7. Applicant's arguments with respect to all claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Erik Kielin

December 1, 2002